

SWITNET

The Space Weather ITalian NETwork and Its Role in the European Scenario

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and

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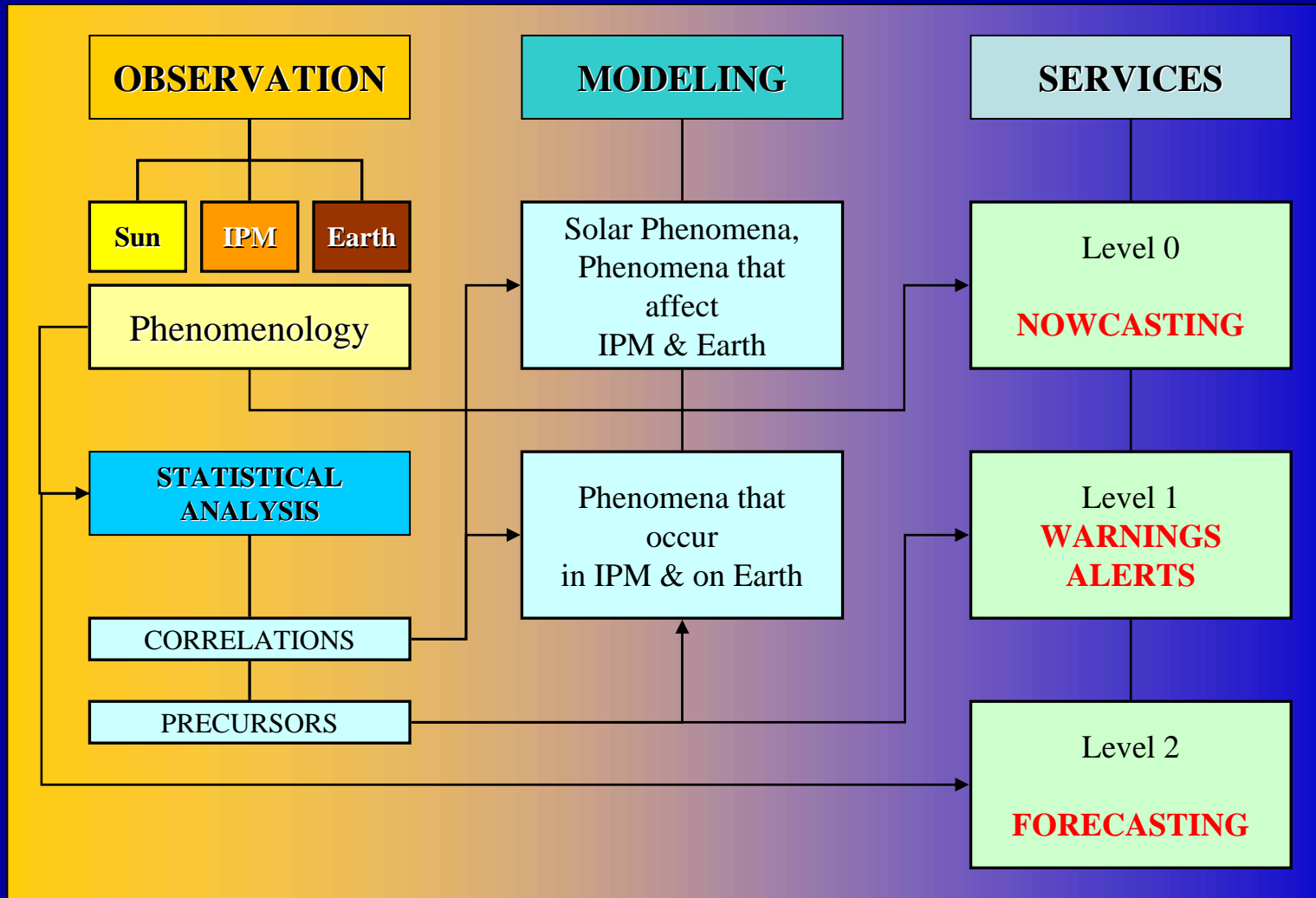


Outline of the Talk

- A Scheme for SpW Monitoring, Modelling and Forecasting
- SWITNET Space Weather ITalian NETwork
- The National, the European and the International Scenarios
- Conclusions



Space Weather Science & Service Scheme



SWITNET

The Space Weather Italian Network



What is SWITNET

SWITNET is not just a network of instruments that operate in coordinated mode, i.e., a service, but it is

- A network of instruments (SINERGIES)

AND

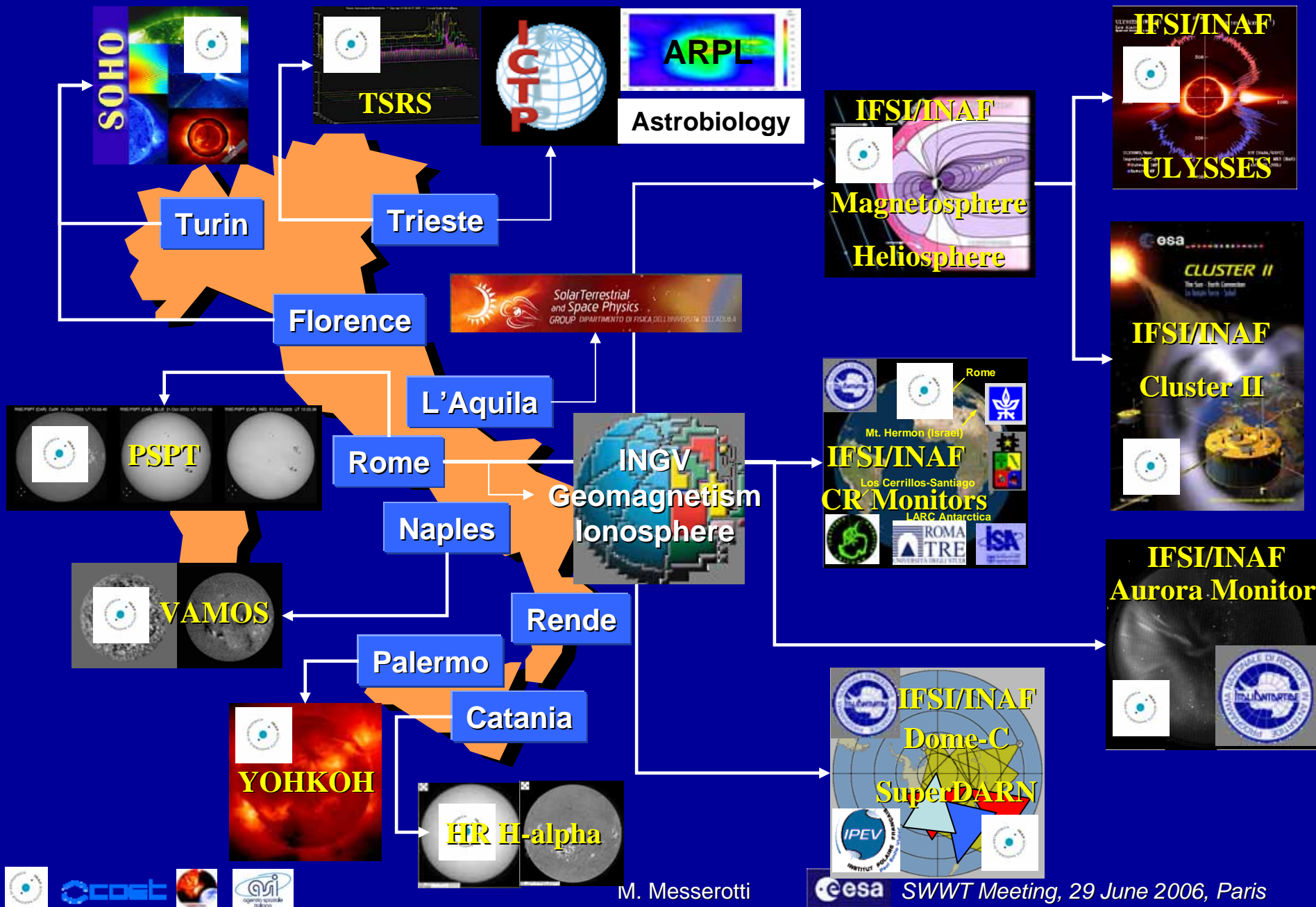
- A network of shared scientific expertise in S, S-T, T physics

AND (when completed)

- An advanced data handling system with processing and knowledge discovery capabilities (IVOSEC)

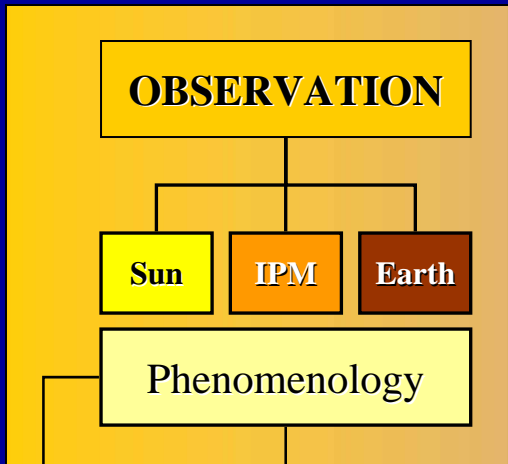


SWITNET at a Glance



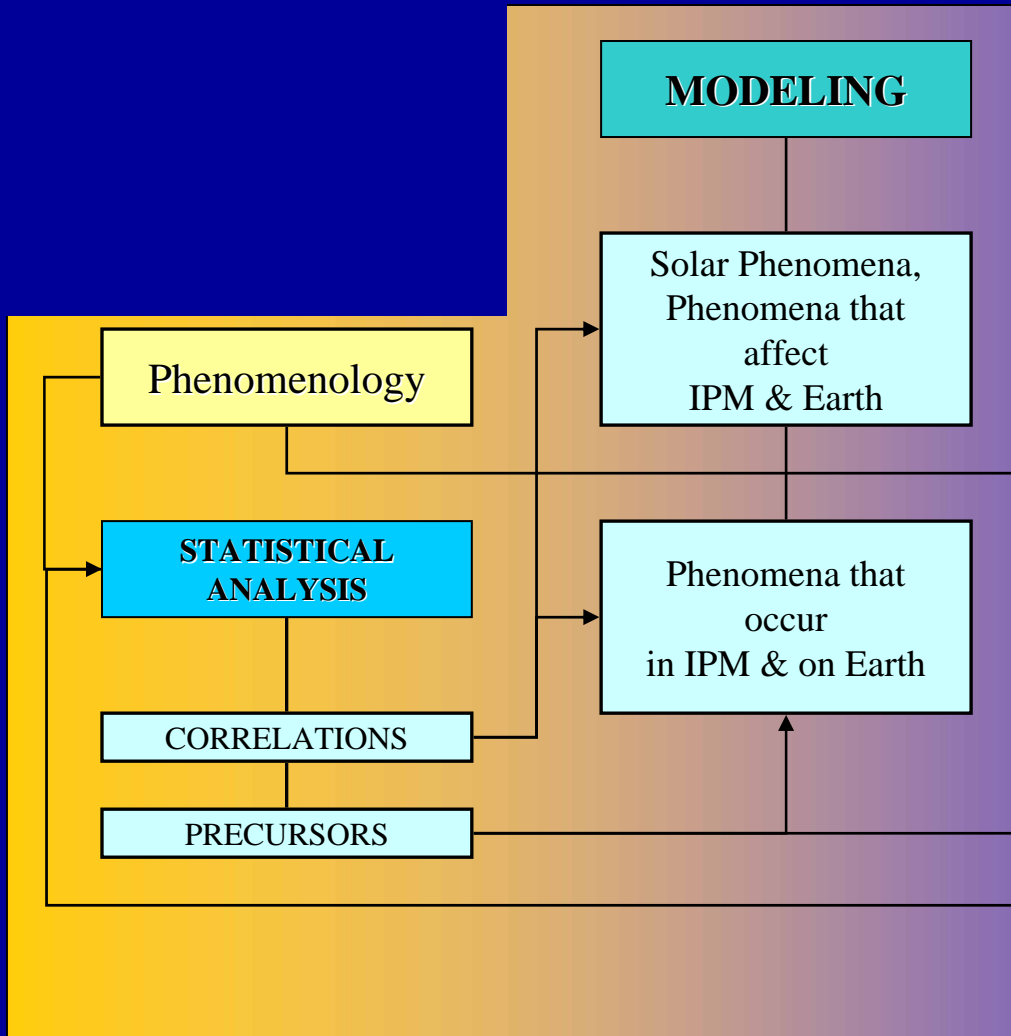
SWITNET Observing Resources

SINERGIES



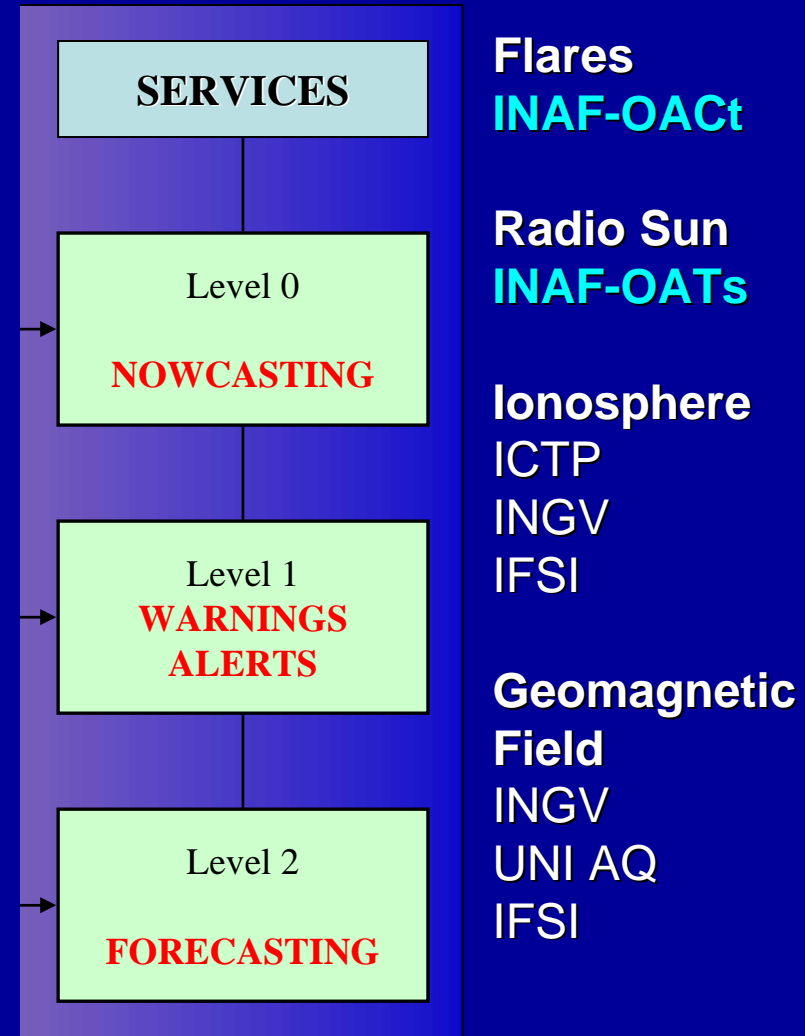
- **INAF-OATo** Solar & Heliospheric Space Observations
- **INAF-OATs** Trieste Solar Radio System
- **INAF-OAA** Next generation large aperture solar telescopes
- **UNI Fi** Solar & Heliospheric Space Observations
- **INAF-OAR** PSPT & CVS
- **UNI Roma 1** MOF
- **UNI Roma 2** Next generation large aperture solar telescopes
- **UNI Roma 3** Mini-Network of Neutron Monitors (see IFSI)
- **INAF-IFSI**
 - Solar & Heliospheric Space Observations
 - Magnetospheric & Ionospheric Observations
 - Mini-Network of Neutron Monitors
 - Antarctica Monitors
- **INGV**
 - Geomagnetic & Ionospheric Observations
 - Antarctica Monitors
- **UNI AQ**
 - Magnetospheric Observations (SEGMA magnetometer array & Antarctic stations)
- **INAF-OAC**
 - MOF (VAMOS)
 - Antarctica Observations
- **INAF-OACT** WL & H-alpha solar observations

SWITNET Modelling Resources



- All the previous institutes
- **ICTP**
 - Ionosphere Modelling
 - Astrobiology
- **UNI Na**
 - Flare physics
- **UNI Cal**
 - Turbulence
 - Flare precursors
- **UNI Ct**
 - AR formation
 - Flare precursors
 - Flare physics
- **INAF-OAPa**
 - Hydrodynamics of flux tubes
- **UNI Pa**

SWITNET Forecasting Resources



SWITNET

Advanced Data Handling and Integration





IVOSEC

The Italian Virtual Observatory for Sun-Earth Connections

IVOSEC Expected Features

- Based on SOLARNET as core architecture
- Can include S, S-T, T data bases
- Can handle real-time data ingestion and retrieval
- Is operable via an advanced web GUI for complex queries in user-transparent mode
- Has capabilities for distributed processing for data visualization and analysis (V-Grid)
- Is compliant with VO standards





SOLARNET

Italian Solar Archives Federation

Hosted by INAF/Osservatorio Astronomico di Torino



[Home](#) | [Search](#) | [Nodes Info](#) | [Tools](#) | [EGSO/SEC](#) | [EGSO/DSO](#) | [Telescopes](#) | [Doc](#)



Nodes

- SOLAR
- SOLRA
- PSPT
- DISCO/VAMOS
- CATANIA

EGSO Resources

- EGSO/SEC
- EGSO/DSO

Availability

Welcome to the SOLARNET Portal for browsing and retrieving Italian Solar Archives data.

The national project SOLARNET (SOLAR ARchive NETwork) aimed to federating all the Italian solar archives as a distributed database, is the first step toward an Italian Virtual Solar Observatory, which interconnects the distributed resources and available solar data in a unified database by a web user interfaces. Different user interfaces allow searches of all participating data services using different input parameters. Currently there are 5 data providers in SOLARNET:

SOLAR, SOLRA, PSPT, DISCO/VAMOS and CATANIA archives, plus two services that the Italian solar community has developed for the EGSO project: SEC (Solar Events Catalog) and DSO (Database for Solar Observatory).

Search by:

[Date/Time](#)

[Date/Time, Instrument](#)



European Grid of Solar Observations

Site Navigation

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Introduction

EGSO, the "European Grid of Solar Observations", is a Grid test-bed that will lay the foundations of a "Virtual Solar Observatory".

EGSO addresses the problem of combining heterogeneous data from scattered archives of space and ground-based observations into a single "virtual" dataset. The project will also create catalogues of solar features and observation data to enable innovative searching, and provide visualisation tools for user-friendly data browsing. EGSO will be a unique resource for the solar physics community, while also serving as an interface to solar data for the Space Weather, Climate Physics and Astrophysics communities.

EGSO is funded under the Information Society Technologies (IST) thematic programme of the European Commission's Fifth Framework Programme. The project is one of many partners from across Europe that co-operate through the EU GRIDSTART initiative. EGSO is also working closely with the Virtual Solar Observatory (VSO), Collaborative Sun-Earth Connector (CoSEC) and the Virtual Space Physics Observatory (VSPO) projects, all funded by NASA.



EGSO News

[Try out EGSO](#)

The current capabilities of EGSO can be tested, including the main GUI and SEC, SFC and DSO

April 2005

EGSO presented at the European Geophysical Union in Vienna

April 2005

EGSO presented at the UK National Astronomical Meeting in Birmingham

December 2004

EGSO demonstrated at the American Geophysical Union in San Francisco, CA

Italian Team

- **INA-OATo**
National Coordinator
- **INAF-OATs**
Technical Coordinator
- **INAF-OAA**
- **INAF-OAC**



The Role of SWITNET in the National Scenario



Participation in ASI Programs

- SWITNET is an Enabling Science integrated resource by providing
 - Ground-based support to operating and planned space missions for the exploration of the S-T environment
 - Availability of expertise in Theoretical and Numerical Modelling of the relevant plasma processes
 - Availability of expertise in Data Analysis and Interpretation
 - Advanced Data Handling capabilities to be interfaced with the ASI Science Data Center



The Role of SWITNET in the European Scenario



Participation in ESA SWENET

- Upon completion, SWITNET will be flawlessly interfaced with SWENET, the Space Weather European Network promoted by ESA through a Pilot Project.
- To date, the previsional resources:
 - GIFINT (Geomagnetic Indices Forecasting and Ionospheric Nowcasting Tools) operated by INAF-IFSI, INGV and UNI Aq
 - TSRS (Trieste Solar Radio System Radio Indices) operated by INAF-OATsare already integrated in SWENET.



The Role of SWITNET in the International Scenario



Collaboration with Int'l Organizations

Active collaborations (both scientific and organizational) exist with the following international organizations/projects

- COST Action 724 (Developing the Scientific Basis for Monitoring, Modeling and Predicting Space Weather)
- COST Action 296 (Mitigation of Ionospheric Effects on Radio Systems)
- CAWSES (Climate And Weather of the Sun-Earth System) by Scostep
- ILWS (International Living with a Star)
- E-Star
- ICESTAR by SCAR



Organization of Advanced Schools in 2006

- The Physics of the Sun: The Active Sun on Your Active Desktop (ISSS, L'Aquila, March 27-April 1, 2006)
- ICTP-COST-USNSWP-CAWSES-INAF-INFN International Advanced School on Space Weather (ICTP, Trieste, 2-19 May 2006)
- Advanced School in Space Environment ASSE 2006: Solar-Terrestrial Physics (ISSS, L'Aquila, 10-16 September 2006)



Involvement in International Initiatives

- IHY Int'l Heliophysical Year
- IGY Int'l Geophysical Year
- IPY Int'l Polar Year
- eGY Electronic Geophysical Year



Conclusions

1

- SWITNET is a comprehensive geographic network of shared
 - ground-based instruments
 - modelling expertise
 - forecasting toolsfor monitoring, modelling and forecasting SpW
- SWITNET data handling will be managed soon by IVOSEC, the Italian Virtual Observatory for Sun-Earth Connections



- **Relevant Issues**

- Growing interest in Europe and in the world for SpW
- SWITNET
 - Completeness
 - International relevance
 - Test-bed for state-of-the-art data handling
 - Ground-based support to space missions
 - Enabling science resource
 - Resource for Education and Public Outreach
 - Italian expertise has been acquired for decades

THE SOLAR CYCLE AND TERRESTRIAL CLIMATE

INVITED SPEAKERS

F. Moreno Inerols
O. R. White*
D. Schmideke
S. Solanki
M. Lockwood
A. Ferris alias
S. Solis
H. Crossman
P. Ulmer
J. R. Christy
J. Hansen
C. Frohlich
J. A. Durr
U. Schüssler*
M. Sugi
J. F. Roychoudhury
E. Pätzold
* to be confirmed

CONTACTS

website
<http://www.iaac.es/proyecto/solspa/index.html>
e-mail
solspa2000@iaac.es
fax
34 922 685 210

SCIENTIFIC ORGANIZING COMMITTEE

B. Schmieder (France, Co-chair)
M. Vázquez (Spain, Co-chair)
P.N. Brandt (Germany)
D. Couzzi (Italy)
E. Dally (ESA)
G. Flork (ESA)
E. Friis-Christensen (Denmark)
M. Noguer (IPCC)
R. Marsden (ESA)

LOCAL ORGANIZING COMMITTEE

M. Vázquez (Chair)
J. de Araoz Vigil
L. R. Retret Rubio
J. A. Bonet
A. Eit-Darwich
A. Jiménez
T. Korbhaus
V. Martínez Pizar
H. González Jorco
I. Rodríguez Hidalgo

Solar and Geophysical Databases

Solar and Geophysical Databases: The Tiles of a Planetary Meta-Archive


M. Messerotti

Trieste Astronomical Observatory

Data Organization

- 
- **Matter of Fact** **Huge amount of space and g-b data**
 - **Data Organization** **Databases, Archives, Meta-Archives**
 - **Data Indexing** **Tables, Catalogs managed by RDBMS**
 - **Data Access** **FTP, TELNET, WWW via GUI**
 - **Data Search** **Local, Distributed over the net**
 - **Data Analysis** **Local**

Scientific Requirements

- 
- **Physical modelling** **MULTIWAVELENGTH DATA SEARCH**
MULTIWAVELENGTH DATA DISPLAY
MULTIWAVELENGTH DATA ANALYSIS
via a common unified, user-friendly interface
 - **Space Weather** **SOLAR, SPACE, EARTH DATASETS**
MULTI-EVENT MODELLING
LARGEST COVERAGE POSSIBLE
 - **Event Prediction** **CROSS-SEARCH OVER ARCHIVES**
STATISTICAL ANALYSES
REAL-TIME DATA AVAILABILITY

Scientific Motivations

- **Some major Solar-Terrestrial Data Portals exist**
- **Mainly Resource Indexing is available**
- **Few resources partially allow complex, distributed data searching over limited subsets of databases**
- **Very few resources partially allow data analysis on inhomogeneous datasets**

A PLANETARY META-ARCHIVE IS NEEDED TO EXPLOIT THE FULL SCIENTIFIC POTENTIALITIES OF MULTIWAVELENGTH MODELLING IN SOLAR-TERRESTRIAL PHYSICS

Solar-Terrestrial Physics Portals

CDS AstroWeb

<http://cdsweb.u-strasbg.fr/astroweb.html>

NASA Space Physics Data System (SPDS)

<http://spds.nasa.gov/>

NASA Space Physics Data Facility (SPDF)

<http://nssdc.gsfc.nasa.gov/spdf/>

Magnetospheric Yellow Pages

<http://nssdc.gsfc.nasa.gov/spdf/yellow-pages/data-by-type.html>

NASA National Space Science Data Center (NSSDC)

<http://nssdc.gsfc.nasa.gov/>

Canadian Astronomy Data Center

<http://cadwww.dao.nrc.ca/>



CDS AstroWeb - Astronomy on the Internet

<http://cdsweb.u-strasbg.fr/astroweb/solar.html> (A)

ARTHEMIS	GDC	Hiraiso Solar Terrestrial Research Center/CRL	SEC
BAsE Solaire Sol 2000 (BASS2000)	GDC	IPS Radio & Space Services	SEC
Big Bear Solar Observatory (BBSO)	GSO	Imager for Magnetopause-to-Aurora Global Exploration	ESE
Birmingham Solar Oscillations Network (BiSON)	GSN	Institut d'Astrophysique Spatiale (IAS)	SPI
Boulder, Colorado – Dept. Astrophys. and Planet. Sciences	SRI	Instituto de Astronomía y Física del Espacio (IAFE)	SPI
Catania Astrophysical Observatory (OAC)	SOO	International Solar-Terrestrial Physics (ISTP)	STN
Centre de Prevision de l'activite solaire et geomagnetique	SEC	Joint Organization for Solar Observations (JOSO)	ISO
Cluster II, ESA's spacefleet to the magnetosphere	SSE	Kharkov multi-wave station of solar monitoring (KHAASM)	SRO
Cracow - Solar radio emission in dm wavelength	SRO	Kiepenheuer-Institut für Sonnenphysik (KIS)	SRI
Departement d'Astronomie Solaire (DASOP, Observatoire de Paris)	SRI	Laboratory for Atmospheric and Space Physics (LASP)	SRI
ETH Institute of Astronomy (ETH Zurich)	SRI	LASCO/SOHO	SSE
Estación de Observación Solar / Solar Observational Station (EOS)	SOO	MEDOC (Multi-Experiment Data Operations Center for SOHO)	SDC
European Incoherent SCATter	GIN	MSU Solar Physics Group (Montana)	SRI
GALLEX	GPE	Mees Solar Observatory (MSO, Hawaii)	SOO
Global Oscillation Network Group (GONG)	GSN	Metsahovi Radio Research Station	SRO
Haleakala Observatories (Hawaii)	SOO	Mount Wilson Observatory	SOO
High Altitude Observatory (HAO)	SOO	NRL Solar Physics Branch	SRI
High Energy Solar Spectroscopic Imager (HESSI)	SSE	National Astron. Obs. of Japan - Solar Phys. Division	SRI

CDS AstroWeb - Astronomy on the Internet

<http://cdsweb.u-strasbg.fr/astroweb/solar.html> (B)

National Solar Observatory (NSO)	SOO	Space Environment Center	SEC
NSO Sacramento Peak, Sunspot, NM (NSO/SP)	SOO	Stanford SOLAR Center	SEC
Naval Research Laboratory Space Science Division (NRL SSD)	SPI	Sternberg Astronomical Institute (Heliophys. and Seismology)	SRI
Observatoire Midi-Pyrenees (OMP)	SOO	THEMIS	SOI
Service d'Aeronomie	EDC	The INTER-SOL Sun Observation Programme (ISP)	GSN
Soft X-Ray Telescope onboard Yohkoh Satellite, ISAS, Japan	SSE	Transition Region And Coronal Explorer (TRACE)	SSE
Solar Data Analysis Center (SDAC)	SEC	Universitat de les Illes Balears - Solar Phys. at Dept. of Phys.	SRI
Solar Extreme-ultraviolet Rocket Telescope and Spectrograph	SSE	Wilcox Solar Observatory (WSO)	SOO
Solar Flare Theory (NASA/Goddard Space Flight Center)	SRI	Yohkoh Public Outreach Project (YPOP)	SSE
Solar Group of RATAN-600	SRO	Zurich Solar Radio Spectrometer	SRO
Solar Physics Division - American Astronomical Society	NSO	<h2>64 Entries</h2>	
Solar Physics at Stanford University	SRI		
Solar Terrestrial Activity Report	SEC		
Solar Terrestrial Dispatch (STD)	SEC		
Solar UV Atlas from HRTS (HRTS data)	SDC		
Solar and Heliospheric Observatory (SOHO)	SSE		
Solar, Auroral, Ionospheric, ... Information (Lethbridge, Canada)	SEC		
Solar-Terrestrial Physics Home Page (STP)	SEC		

Goals

- **Index observational resources in ST Physics**
- **Index theoretical resources in ST Physics**
- **Allow**
 - **User-transparent data access to distributed datasets all over the world**
 - **Complex data searching, retrieval and analysis via a simplified common GUI**

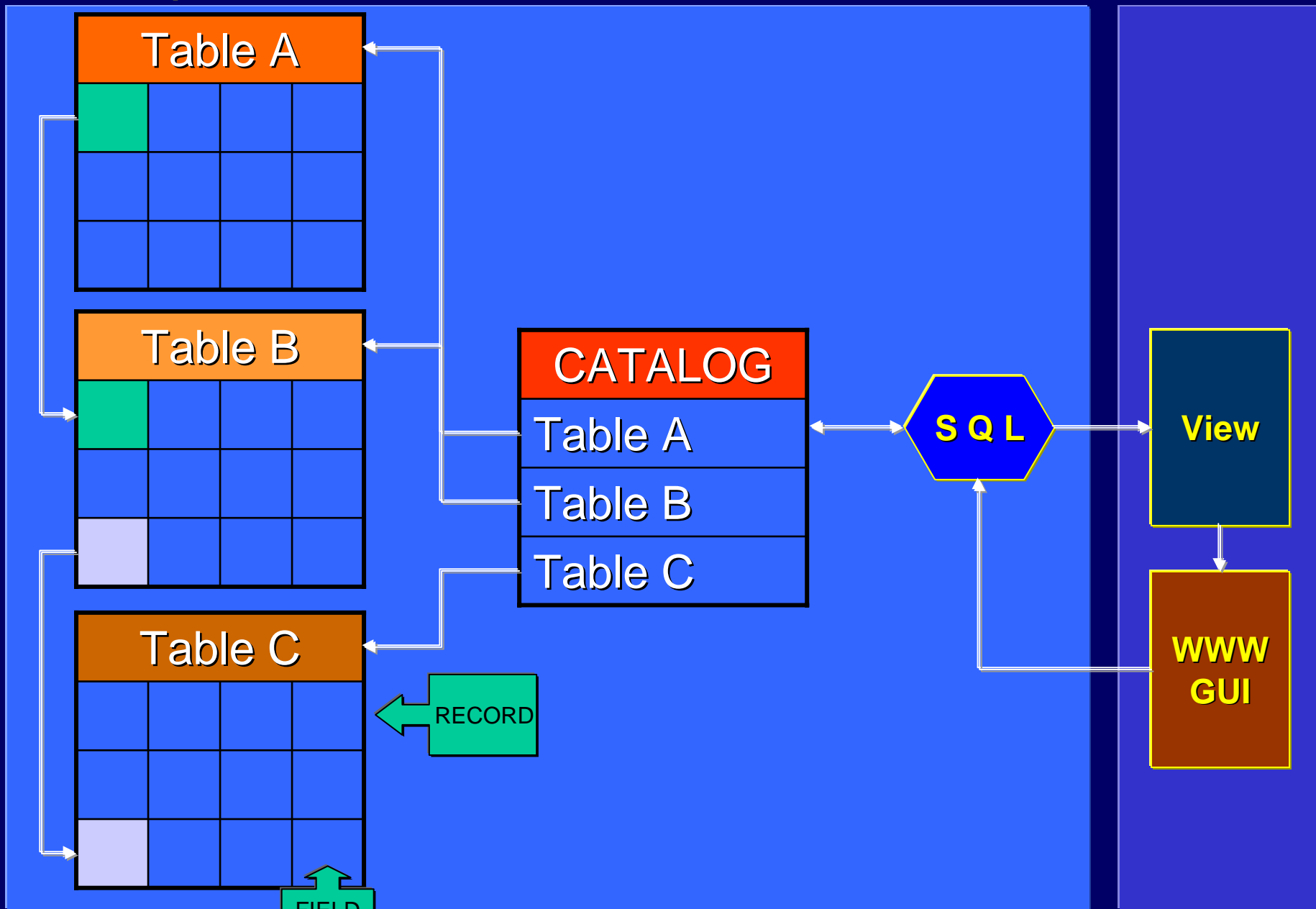
PRESENT DATA ARCHIVING TECHNOLOGIES ALLOW THE ACHIEVEMENT OF SUCH GOALS PROVIDED THAT A GLOBAL COORDINATION AND COLLABORATION IS ESTABLISHED AS WELL AS THE ALLOCATION OF PROPER FINANCIAL RESOURCES BY THE PARTICIPATING ORGANIZATIONS

Advances in Solar and Solar-Terrestrial Data Archiving and Retrieval Techniques

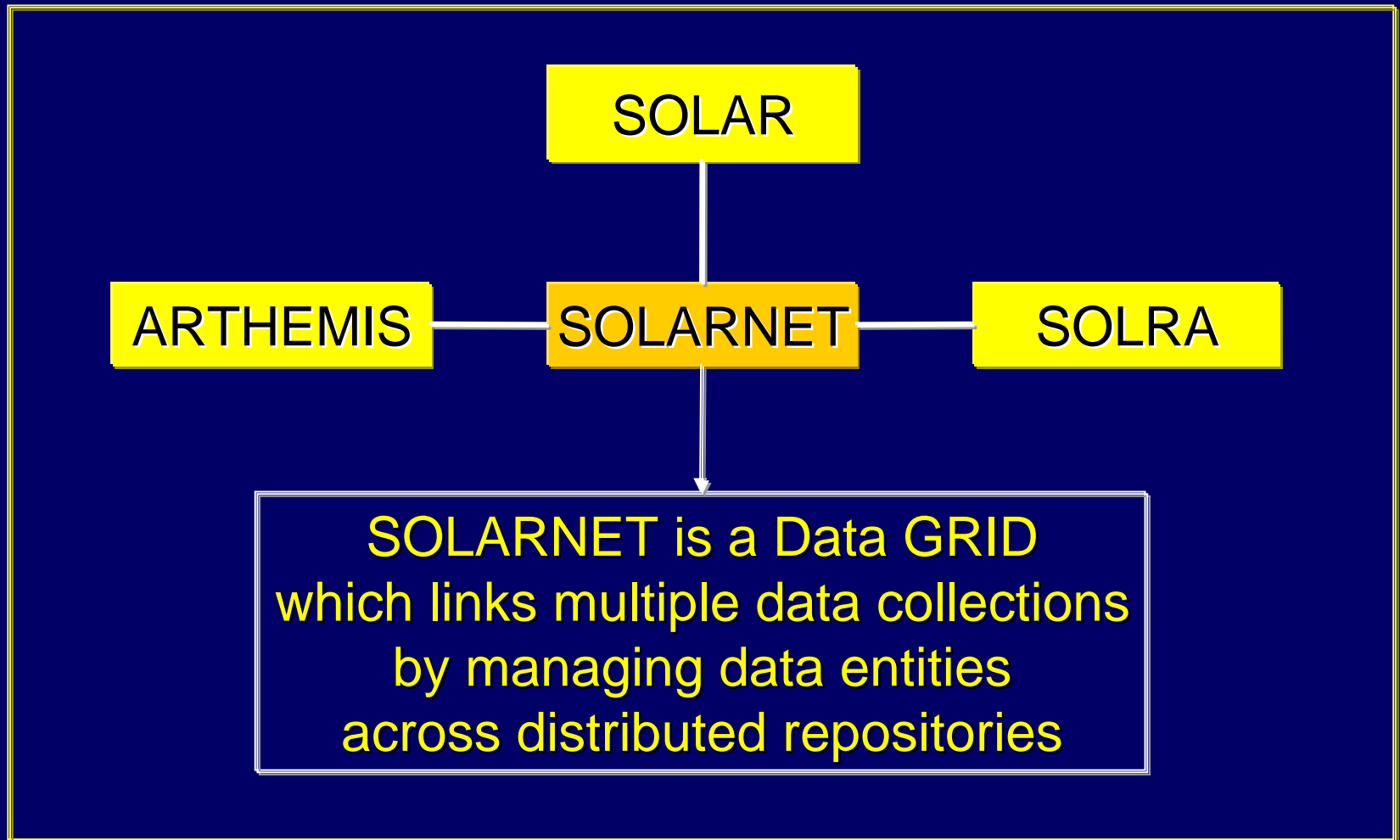
M. Messerotti

*INAF-Trieste Astronomical Observatory
and
Physics Department, Trieste University*

Simplified Architecture of an SQL-Based RDBMS



DATA GRID Architecture

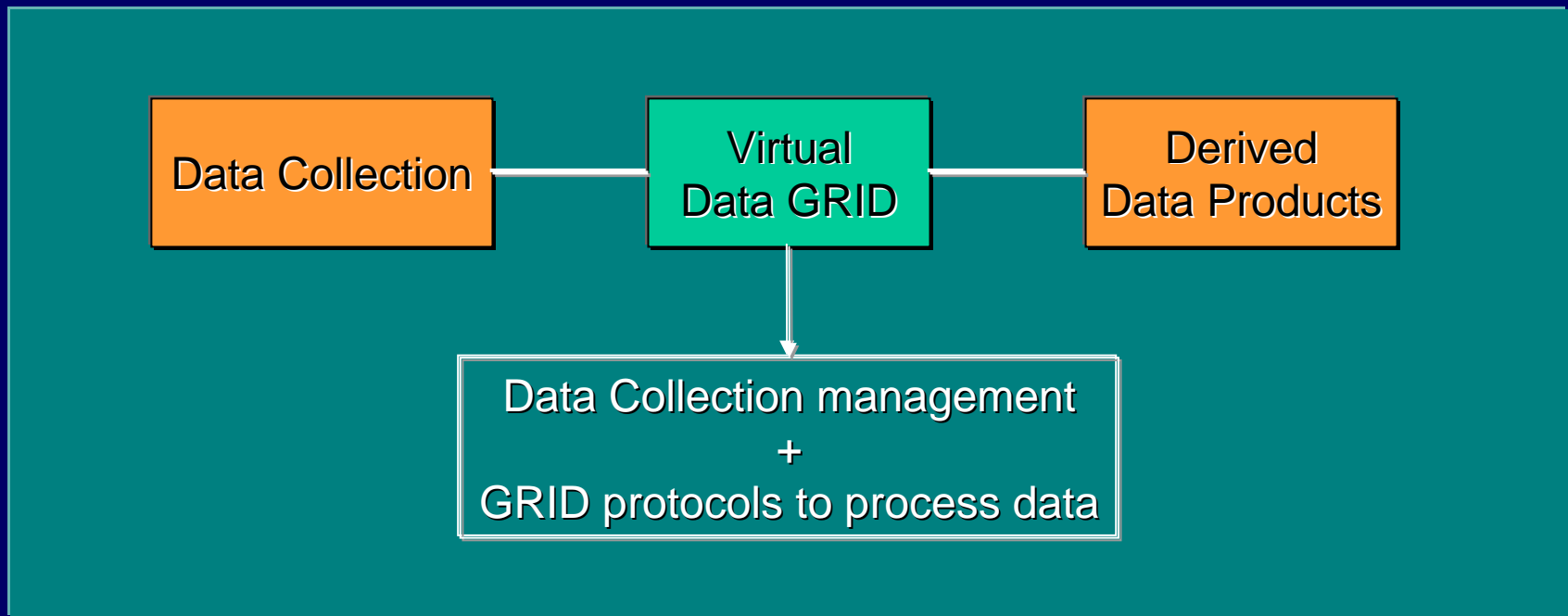


VIRTUAL DATA GRID Architecture

A consistent modelling requires a multi-instrument multi-wavelength approach



DATA ANALYSIS must be provided in addition to **SEARCH and RETRIEVAL**



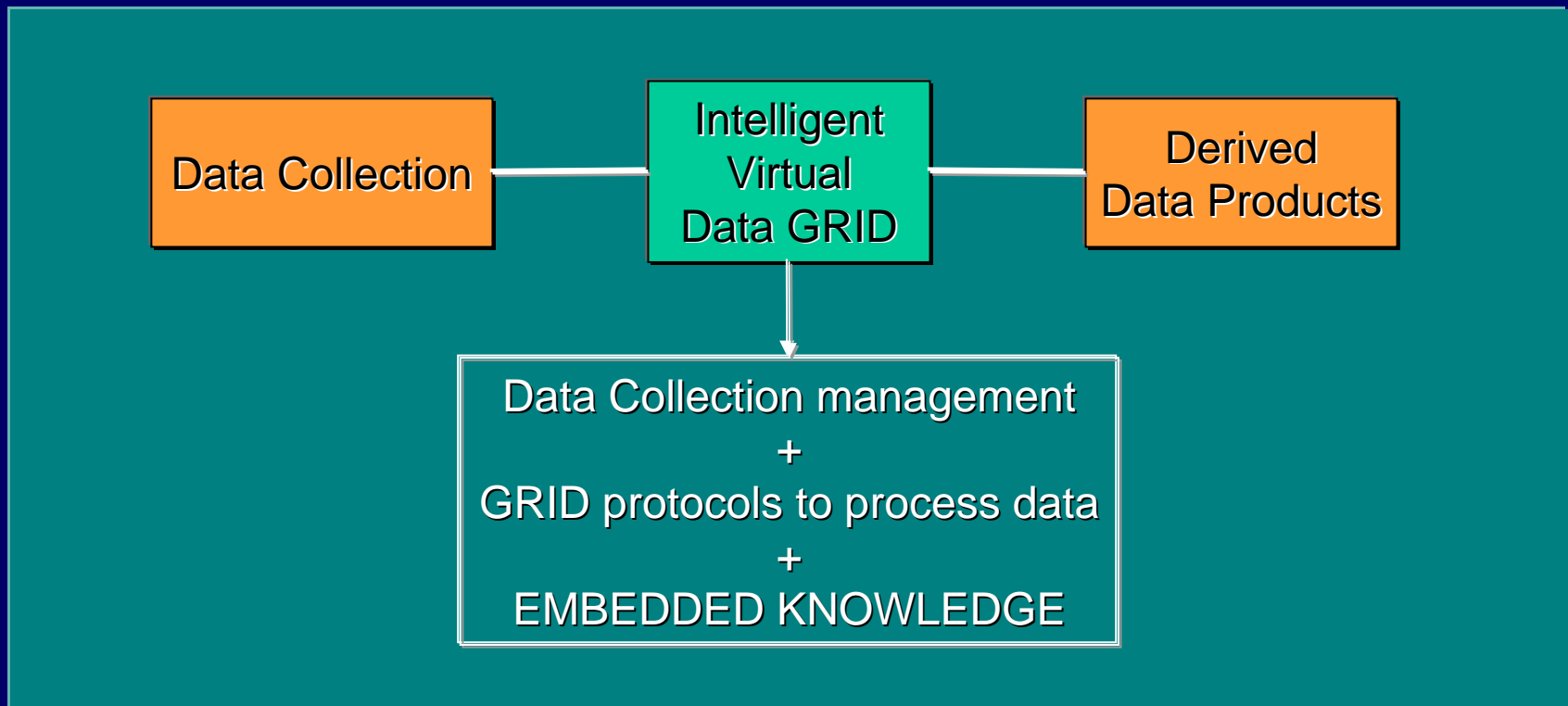
EGSO European Grid of Solar Observations

INTELLIGENT VIRTUAL DATA GRID Architecture

KNOWLEDGE DISCOVERY IN DATABASES (KDD)



DATA ASSOCIATION AND GUIDED PROCEDURES are EMBEDDED



ADVANCED GOAL

- Pointing out the **physical associations** in multi-wavelength datasets is the basis of interpretative scientific research
- **Concept association** is the kernel of knowledge
- **Automated storage and search of knowledge in databases is possible** through advanced techniques and is called

Knowledge Discovery in Databases (KDD)

- Advanced techniques are based on **Artificial Intelligence (AI) and Expert Systems (ES) embedding**

THE EMBEDDING OF AI-ES TECHNIQUES IN THE GRID ARCHITECTURE REPRESENTS THE NEXT GENERATION IN DATA SEARCH, RETRIEVAL, PROCESSING AND ANALYZING

CONCLUSIONS

- S-T space and ground-based observatories operate
 - set of instruments which operate at different wavelengths and produce inhomogeneous 1-, 2-, 3-, 4-D datasets
- Many S-T archives exist all over the world
- Modern archiving techniques allow
 - efficient data search and retrieval through
 - a Relational Data Base Management
 - onsite or in a distributed environment (GRID)
- **Next generation archiving techniques will fully exploit the data information via KDD**

An Advanced System for Data Handling in SPW

- Title of contribution STEVM (Solar-Terrestrial Environment Virtual Monitor)
- Proposer M. Messerotti (& al.)
- Relevant MoU objectives Data standardization and accessibility
- Relevant parts of MoU sci. programme Aims of WG4
- Deliverables Resources survey & architecture (& ?)
- Timetable 3-5 years according to final goals
- Required Manpower To be defined according to final goals
- Resources availability Existing Data Archives community
- Expected collaborations With main VO projects (e.g. EGSO)
- Previous experience in the field SOLAR, SOLRA, SOLARNET, EGSO

Space Weather as Driver of Data Homogeneization

- Inhomogeneous and fragmented character of available observations

CAUSES

Difficulties in carrying out a posteriori modelling of complex phenomena

- These limitations are intrinsic to data acquisition mode

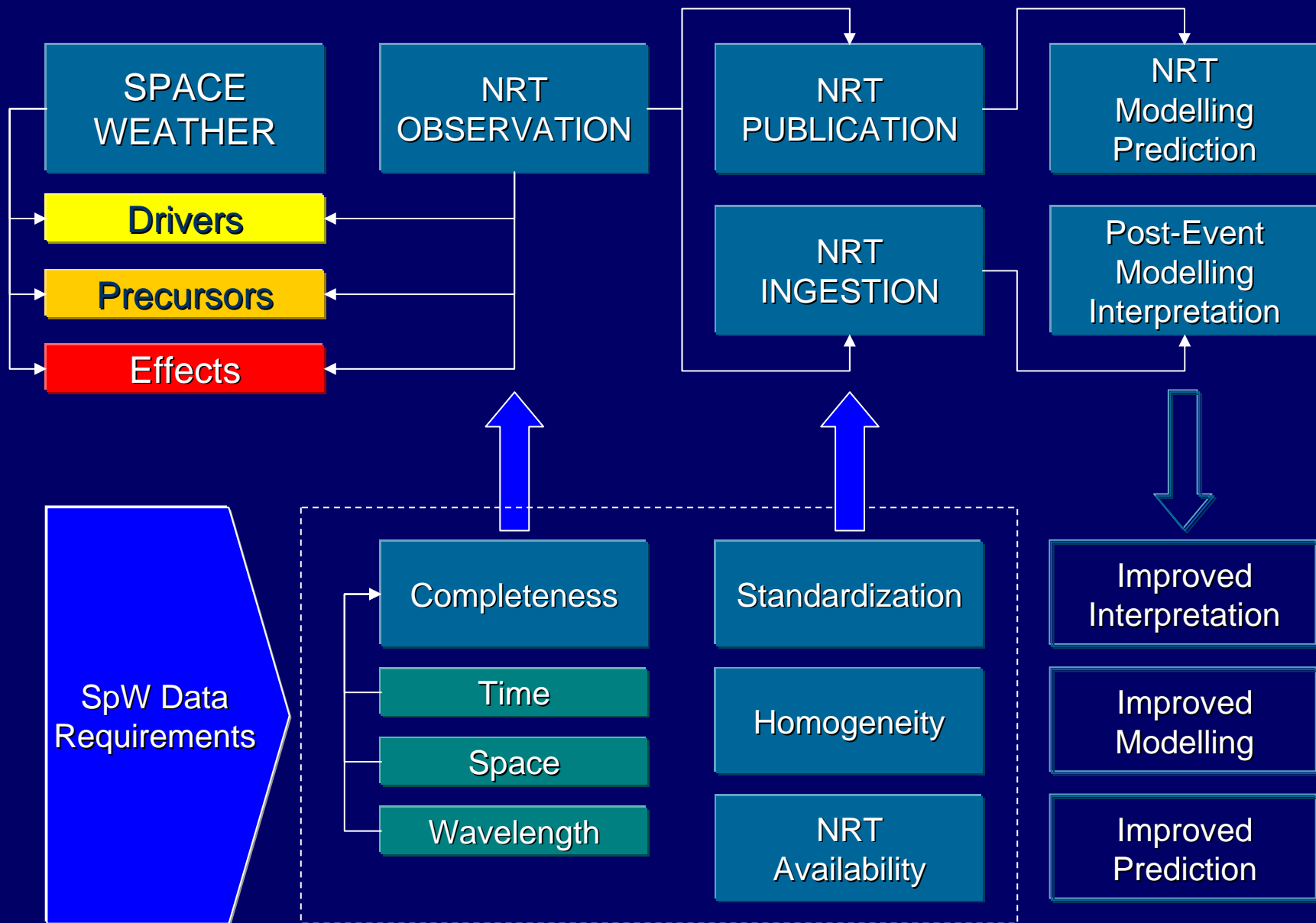
HENCE

Even advanced data search by Grid architectures cannot overcome

DRAWBACKS OF DATA INADEQUACY

- The outcomes are:
 - Inadequate modelling
 - Limited to a subset of phenomenological and physical aspects
 - Often neglects the complex interplays among different processes

Scheme of SpW Data Requirements



The Role of Observing Requirements for SpW

Observing requirements for SpW and SpW drivers observation in monitoring and nowcasting can play a primary role in providing:

1. homogeneization in observations
2. near real-time data ingestion in archives
3. unified data access via web through a user friendly GUI

capable to facilitate:

1. data availability in near real-time
2. full exploitation of the data information content by pointing out interrelationships in different datasets
3. self-consistent modelling



Introduction to the Electronic Geophysical Year, 2007-2008 (eGY)

www.egy.org

messerotti@oats.inaf.it



IGY+50

Four International Year (I*Y) programs are linked to the 50-year anniversary of IGY



International Polar Year



International Heliophysical Year



**Electronic
Geophysical
Year, 2007-2008**



eGY is an initiative of the International Union of Geodesy and Geophysics



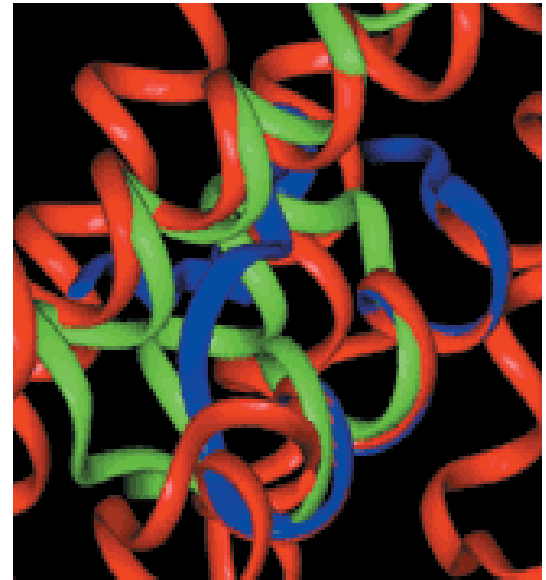
led by the International Association of Geomagnetism and Aeronomy

sponsored by: LASP, NASA, IUGG, IAGA

The information era - interoperability

Modern information and communications technologies have created an “interoperable” information era in which ready access to data and information can be truly universal. Open access to data and services enables us to meet the new challenges of understanding the Earth and its space environment as a complex system:

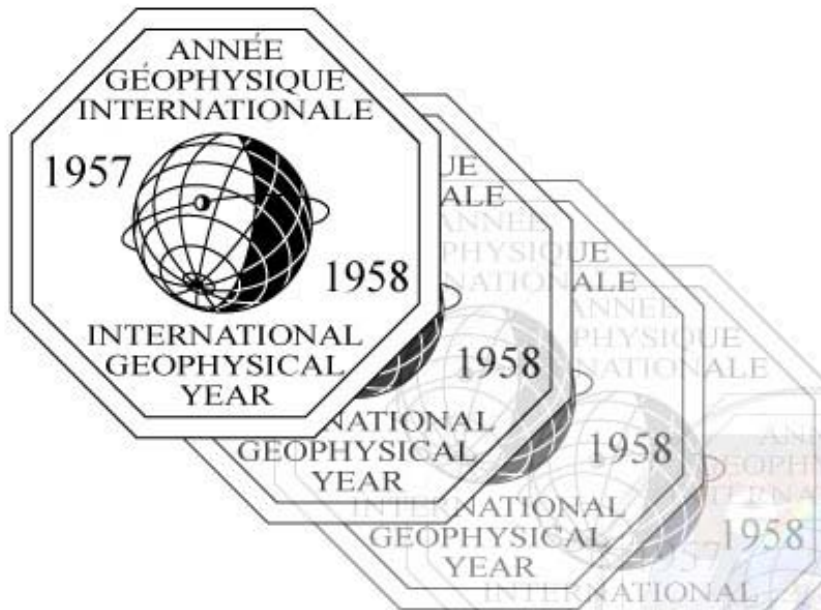
- managing and accessing large data sets
- higher space/time resolution capabilities
- rapid response requirements
- data assimilation into models
- crossing disciplinary boundaries.





Vision

eGY will lead to a major step forward in geoscience capability, knowledge, and usage throughout the world by accelerating the adoption of modern and visionary practices for managing and sharing data and information.



eGY embraces and extends IGY principles...

International cooperation and data sharing

Universal access to data and information

Timely and convenient access to data

Global, cross-disciplinary scope

Data preservation

Capacity building, especially in developing countries

Education, public outreach, information for decision making





What is eGY?

eGY is a cooperative international effort to address the challenges of modern data stewardship, interoperability (e-Science), and integrative science:

- Ready and open access to distributed data, information and services
- Access to large, complex, and cross-disciplinary data sets
- Real-time access and assimilation of data into models
- Data integration and knowledge discovery
- Data discovery (who holds what, where, how? Metadata issues)
- Data release (secure access permission)
- Data preservation (preserve existing and future data)
- Data rescue (identify and rescue critical data sets at risk)
- Education and public outreach; informing decision makers
- Advancement of science in developing countries (reducing the digital divide)



Role

Facilitate, inform, stimulate, encourage, and promote:

- Modern data access and services (“e-Science for Geoscience”)
- Responsible data stewardship
- Cooperation among bodies/initiatives to reduce duplication and proliferation of standards, and share expertise
- Establishment of **virtual observatories** throughout the geosciences
- Establishment of criteria to determine optimal and minimum funding for data activities supporting research

*e*GY also serves to provide a link between programs with related data and information requirements - IPY, IHY, Planet Earth, and initiatives such as GEOSS.

What value can eGY add?

- Q. There's nothing original in the principles and objectives behind eGY, and lots of informatics (e-Science) initiatives are already taking place, so why bother with eGY?
- A. We need awareness-raising and international cooperation to reduce duplication, reinvention, and proliferation of standards. IGY+50, together with the advent of GEOSS, provides a timely opportunity to help accomplish this. IGY+50 is also an opportunity to expand participation by geoscientists in informatics developments. eGY provides an international framework to help accomplish these goals.



Deliverables

- Networking, links to experts and peers
- Coordination for the I*Y and other programs
- A mandate via the *eGY* Declaration for a Geoscience Information Commons
- Codes of best practice
- Meetings, workshops, and symposia at conferences
- Presentations, articles, brochure, press releases
- Website: www.egy.org and *eGY* News
- Education and public outreach program
- Capacity building activities in developing countries (not yet implemented)

Declaration for a Geoscience Information Commons

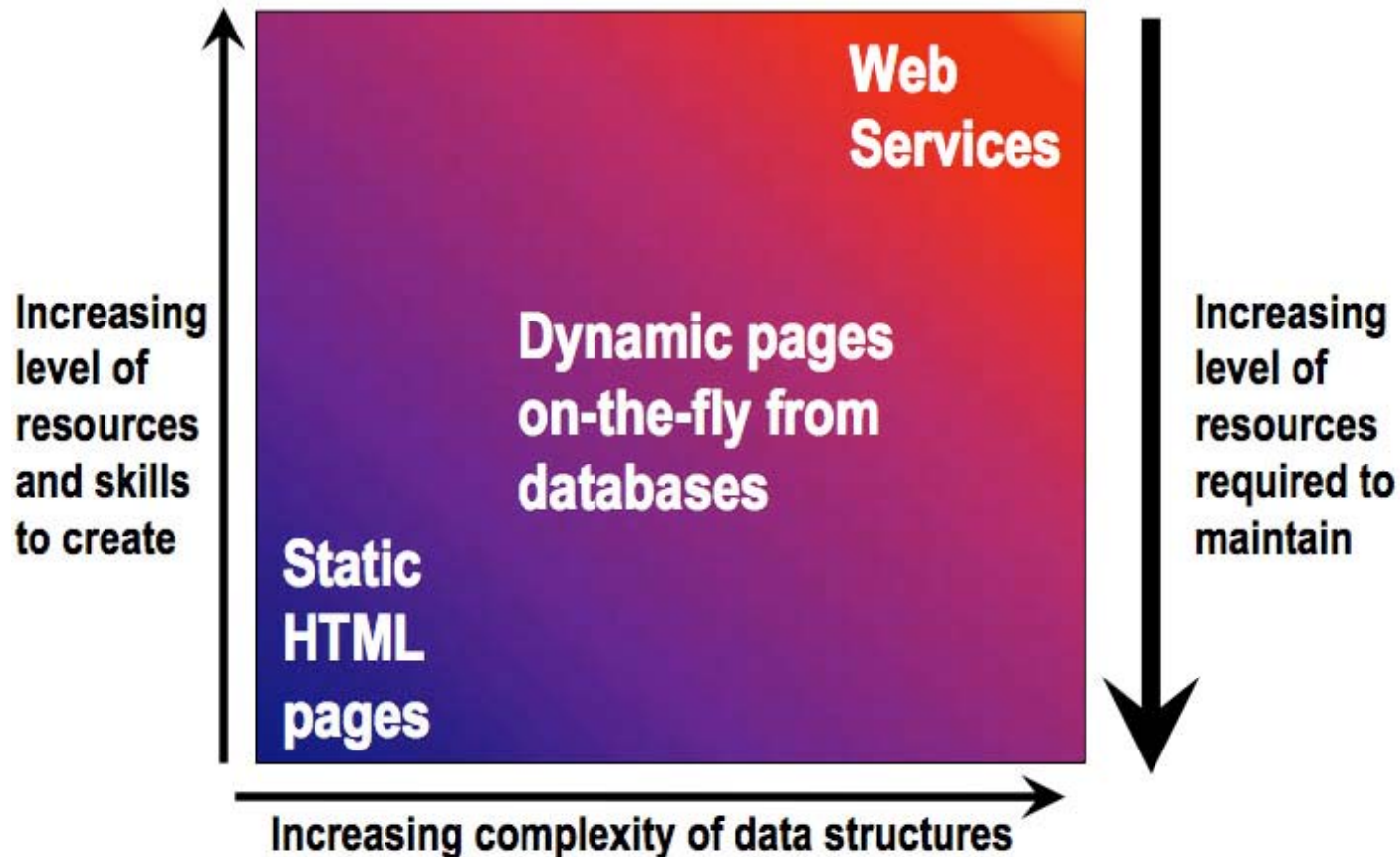
“Knowledge is the common wealth of humanity”

Adama Samassekou, Convener of the UN
World Summit on the Information Society

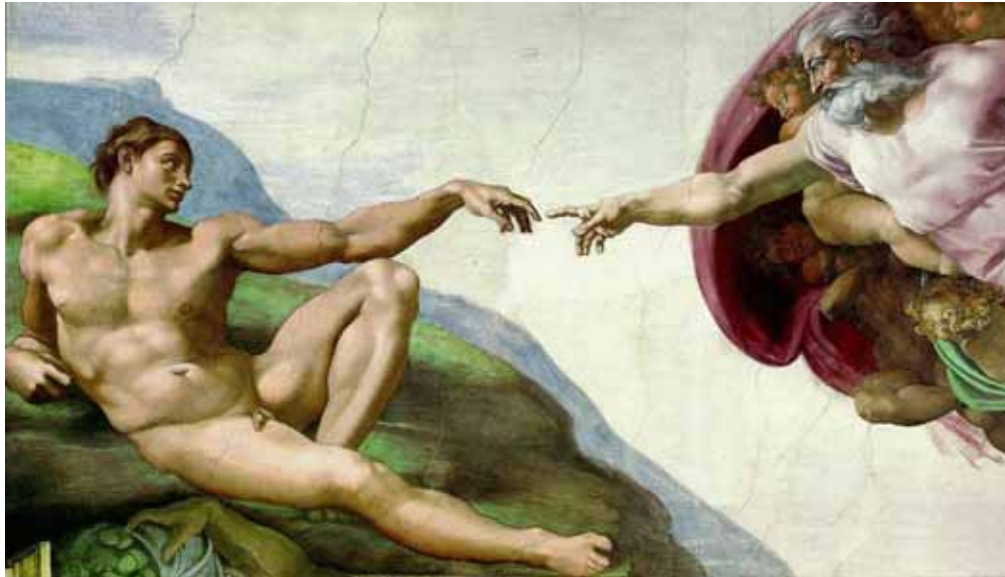
The underlying principles on which eGY is based have been articulated by ICSU, the World Summit on the Information Society, CODATA, and other bodies. The principles are encapsulated in the eGY *Declaration for a Geoscience Information Commons* - a statement of aspirations and principles of data stewardship.

Shifting the burden from the user to the provider

Balancing resources for developing Online access



Challenging the “heroic” science funding paradigm



eGY draws attention to the need to reassessment our reward systems to recognise that the burden of making data and information easily accessible is shifting from the user to the provider.



Structure

Secretariat (at LASP, Univ. Colorado)

Executive Director **Dan Baker, LASP**

Secretary: **Bill Peterson**

Communications: **Marissa Rusinek**

Public Relations and E/PO: **Emily CoBabe-Ammann**

International Committee

Chair: **Charlie Barton**

Representatives from key participants and countries

Thematic Working Groups

Virtual Observatories: **Peter Fox**

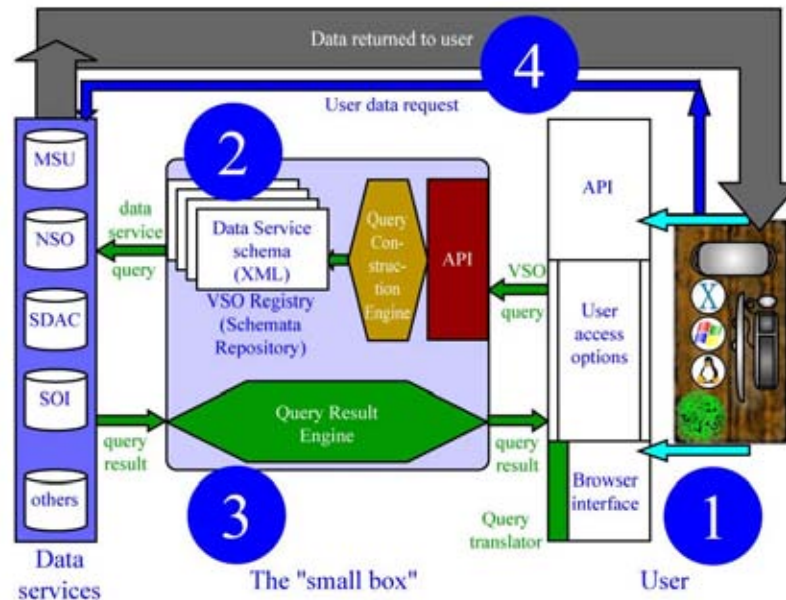
Data Integration & Knowledge Discovery **Paul Berkman**

Best Practice (joint with CODATA): **Herb Kroehl, Jean Bonnin**

Data Rescue and Preservation: **Jeff Love**

Education and Public Outreach: **Emily CoBabe-Ammann**

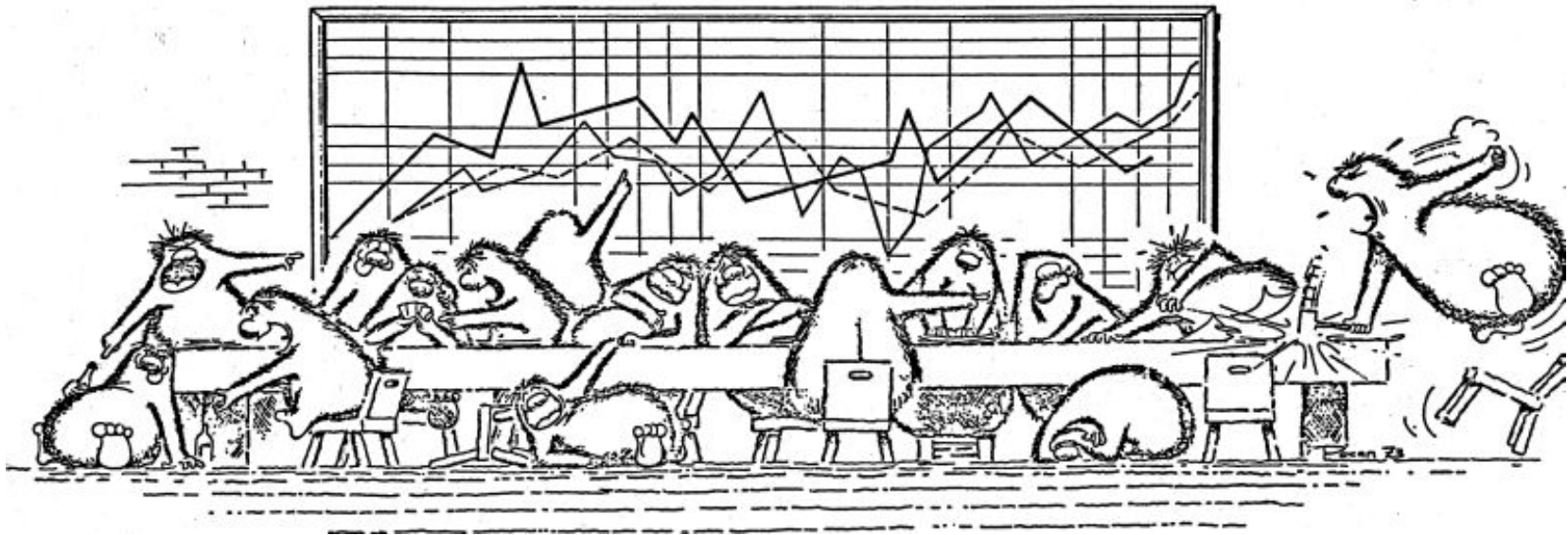
Working Group on Virtual Observatories



Virtual observatories complement in cyberspace the role of physical observatories by providing ready access to data from distributed sources. They also provide processing, analysis, visualisation, and simulation capabilities.

Promoting the development of Virtual Observatories in the Earth and space sciences is a central objective of eGY.

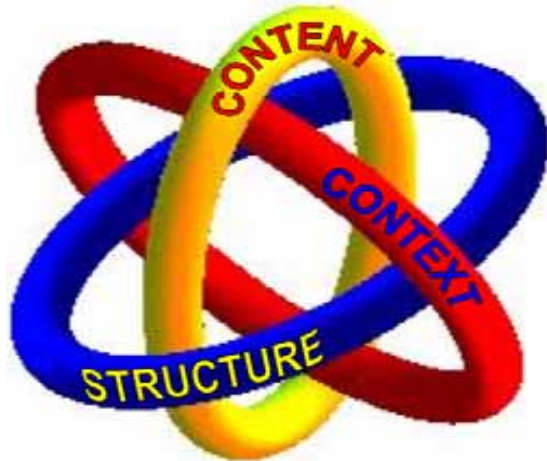
Working Group on Best Practice



Working Group on Data Integration and Knowledge Discovery

The Physics of Information

The way we think about data has changed



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BORROMEAN RINGS

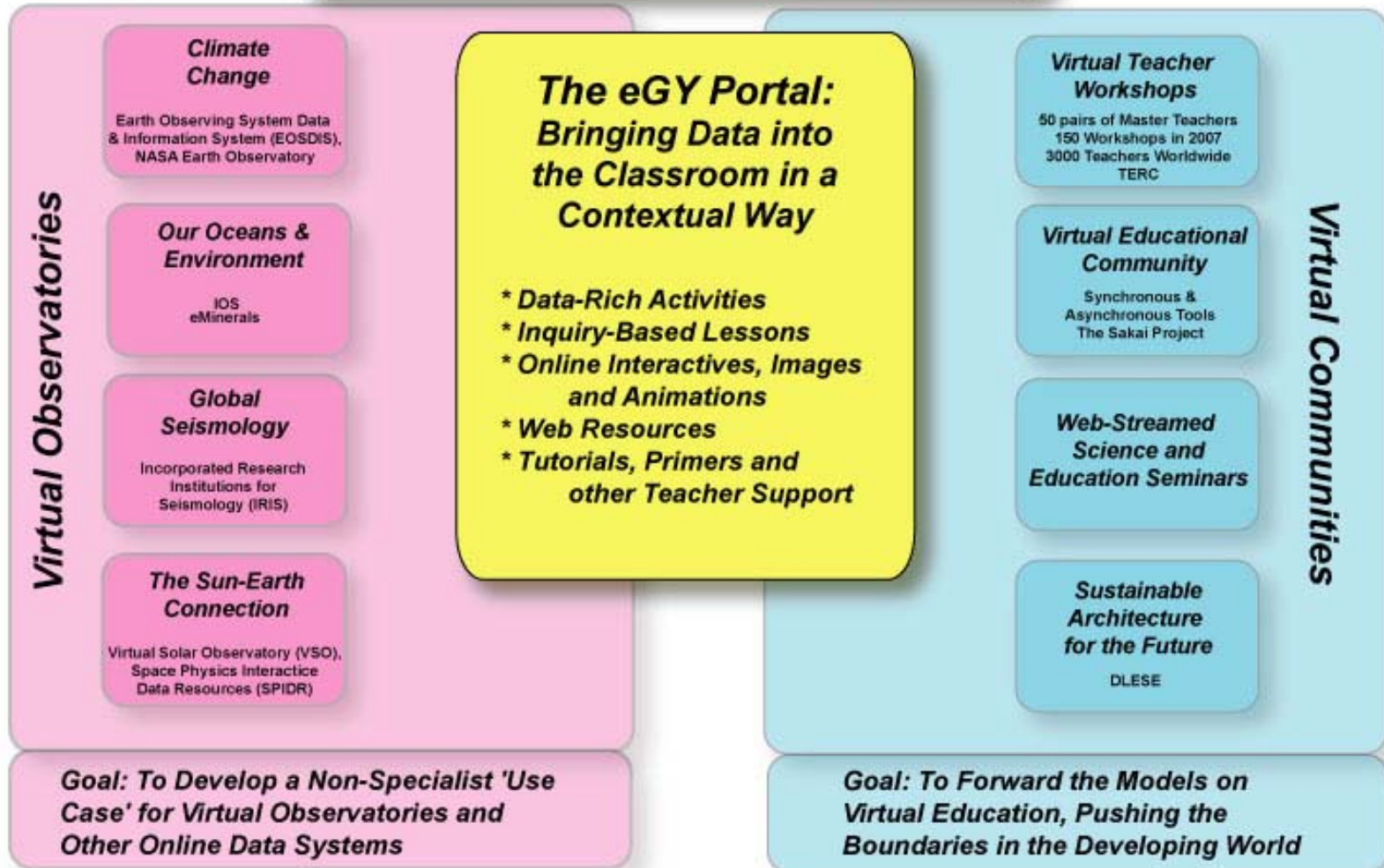
Three interlinked circles that represent inseparable parts of the whole. Remove any one ring and the other two fall apart. Borromean Rings have been used as a symbol of unity in many fields.

Information ingredients – **content**, **context** **structure**.

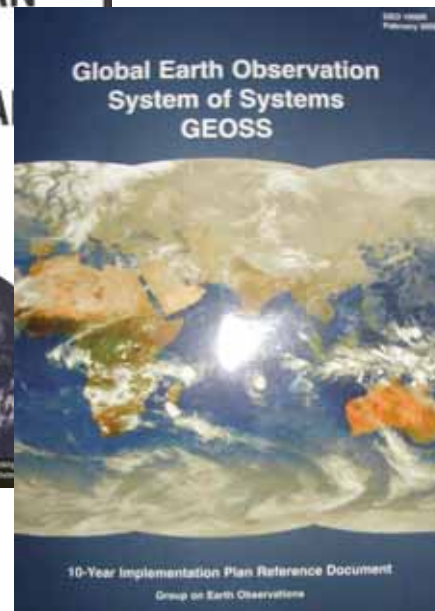
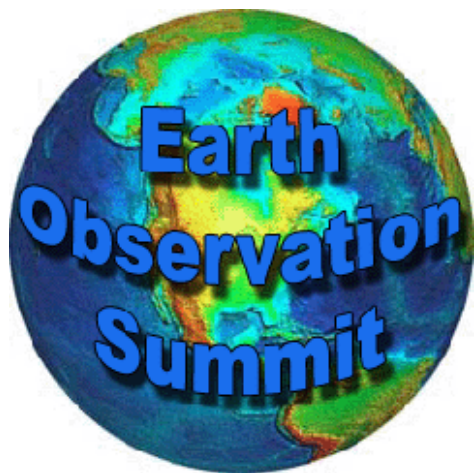
The ability to utilize automatically the inherent structure of information marks the threshold in information management from hardcopy to digital media.

WG: Education and Public Outreach

eGY Education: Connecting Teachers to Science



Discussions are underway with GEO to explore how to use eGY in the development of GEOSS



**world summit
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Interested in getting involved?



www.egy.org

eGY News

Email lists

Sign the “Declaration for a Geoscience Information Commons”

Bill.Peterson@lasp.colorado.edu

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Virtual Observatories in the Geosciences

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